UTILISING DIFFUSE REFLECTANCE INFRA-RED SPECTROSCOPY TO MONITOR THE OXIDATION OF BITUMEN AND ASPHALT AS A RESULT OF ARTIFICIAL AND NATURAL AGEING

HANNAH BOWDEN, MATTHEW ALMOND, WAYNE HAYES, *Department of Chemistry, University of Reading, Reading, United Kingdom*; STUART McROBBIE, *Infrastructure, Transport Research Laboratory, Crowthorne, United Kingdom*.

At present the road surface condition in the UK is monitored visually for any defects. This system works well to identify any major issues; however there is a very short window of time between detecting the defects and the complete failure of the surface. The road then requires resurfacing. It is therefore of interest to be able to predict the failure of the road surface in order to ensure the success of rejuvenation techniques. Asphalt road surfaces are constructed with three main components. Bitumen, a semi-solid, hydrocarbon based tar-like substance; fine filler, commonly calcium carbonate which adds bulk to the bitumen and stone based aggregates. There are many different mechanisms for the degradation of the road surfaces that involve chemical and physical factors. The chemical oxidation of bitumen is a contributing factor to the ageing of the asphalt road surfaces. The increase in oxygen levels within the composition and the loss of the lower molecular weight volatile components increases the polarity of the bitumen and leads to an increase in stiffness. As the bitumen becomes more brittle it loses its cohesion and adhesion with the aggregates and the surface begins to deteriorate. Bitumen oxidation can be monitored with the use of FTIR spectroscopy. The evolution of oxidation product functional group absorbance bands, including carbonyl, carboxylic and sulphoxide bonds can be monitored. This phenomenon has been well documented for raw bitumen but is less well understood for real road surfaces. This work investigates the use of diffuse reflectance IR spectroscopy, a non-contact measurement, to monitor the oxidation of bitumen and asphalt and relate this to pavement degradation. A number of different bitumen and asphalt samples have been aged naturally and artificially. Reflectance spectra have been collected alongside standardised mechanical testing of the physical properties of the bitumen in order to determine a link between the chemical and physical degradation. Preliminary results from this work identify the presence of oxidation product absorbance bands in the reflectance spectra as a result of ageing alongside a decrease in mechanical cohesion and an increase in stiffness and viscosity at lower temperatures.